

having a dark areola, and there is a very great difference in the form and extension of the marginal (and especially of the anterior marginal) plates.

Along with the above specimen, Capt. Speke has also sent to the British Museum a specimen of *Testudo pardalis*, which differs from the general ventricose form by being elongated, like the Indian *Testudo stellata*. It is very solid for its size, and the black mark forms rays rather like the Indian species above-named. There are the head and feet of a *Testudo* in the same Collection, in spirits, which are believed to belong to the above shell. They agree with *T. pardalis*, which is peculiar for having the head covered with small scales, and only a pair of rather small thin frontal shields just over the ends of the nose.

XXXIX.—*On the Skeleton of a Seal (Phoca Grœnlandica ?), and the Cranium of a Duck, from the Pliocene Beds, Fifeshire.* By ROBERT WALKER.

Fossils have not heretofore proved common in any of the Pliocene beds of the east of Fife; and although some of our clay-beds have been worked for many years, the discovery of fossil remains in any of them is of rare occurrence; and when they happen to be met with, it is always in the upper clays, no fossils of any kind, so far as I know, having ever been found in the boulder-clay of this district. In the spring of 1857, a nearly entire skeleton of a Seal was discovered in the red brick-clay of Stratheden, about nine or ten miles inland, and ranging from 100 to 150 feet above the level of the sea. This specimen was exhibited, and a paper on its discovery read, by Mr. Page, at the meeting of the British Association in Leeds: the specimen is in the Natural History Museum, Edinburgh. Another Seal, in fully a better state of preservation, was found in the same clay-pit in April 1859, and is now in the Natural History Museum, St. Andrew's. This skeleton, as well as the preceding one, had belonged to a young animal, and had evidently been imbedded in the clay while all the ligaments, if not the muscles, were entire. That this was the case may be inferred from all the bones being in their respective places, any little derangement of position being merely due to subsequent pressure. This skeleton measures about 3 feet 2 inches in extreme length. The vertebral formula is—7 cervical, 15 dorsal, 5 lumbar, 3 sacral, 13 caudal. The skull, which is very thin in this as well as in most of the Seal family, was completely crushed; and it was found impossible to restore more than the occipital and part of the parietal and temporal regions. The cervical vertebræ are all in good

order ; and it may be remarked that the transverse processes of the last are not perforated. But a few of the dorsal are a good deal broken and decayed, more especially the centra, some of which are completely gone : this appears to have been mainly caused by the corroding action of the contents of the stomach and intestines, as all the bones in the gastric region were more or less stained black, while the rest were of a cream-colour. All the other bones may be said to be in good order, although many of them were broken by the pressure they had sustained. They are now, however, restored, and put in their several places, with the exception of a few of the carpal bones of the left arm and two or three of the phalanges of the posterior extremity, which had unfortunately been overlooked in lifting the specimen. The superior maxillaries are completely destroyed ; the only portions of them remaining entire consist of little more than the alveoli of the left side containing the teeth, and a fragment of the right side containing the two posterior grinders. There are five molar teeth on each side, above and below, placed straight in the jaws, with a small space between them. In the upper jaw, the first grinder has a single fang, the next four have double fangs ; but in the second the fangs are connate. Each molar has an anterior and a posterior basal cusp, besides a centre one, which is compressed, conical, and slightly curved backwards in the first four teeth ; in the fifth it is not so large, and is straight up. The anterior cusps are but feebly indicated on all the upper teeth, more especially on the first three or premolars. In the lower jaw, the first two molars of the left side and the first three of the right side are wanting ; of those present, the third, fourth, and fifth have double fangs. The alveolar cavity of the second shows that that tooth had double fangs also, but the fangs appear to have been connate ; the first molar, like that of the upper jaw, had only a single fang. The crowns of the third and fourth molars have each a central conical cusp, slightly curved backwards, one anterior and two posterior basal cusps, while the fifth has only one cusp before and one behind the centre one : in all these lower-jaw teeth the anterior basal cusps are larger than the posterior. The canine teeth are strong, with compressed roots, their upper part round, sharply pointed, and bent backwards. Some of the incisive teeth are lost ; of those preserved, two are much larger than the rest, and have compressed roots and round pointed crowns, with the tips hooked inwards. They appear to belong to the outside of the upper series. The middle incisors are very small and somewhat compressed, the crowns sharp and hooked inward. With the exception of the dorsal vertebræ (which will be immediately noticed), the rest of the bones correspond so closely to those

of the common Seal that there appears to be no peculiarity about any of them deserving of special notice in this place; and some of them will be noticed in the sequel. The dorsal vertebræ are chiefly remarkable for the depressed condition of the neural arches, and the total absence of neural spines in all but the first, and perhaps the second vertebra. In these vertebræ the neurapophyses form a series of flattened domes over the central axis; they are completely coalesced, and project backwards, somewhat lapping over the anterior notch of the contiguous vertebra. In the second vertebra the anterior edge of the middle of the neural arch is exactly on a level with the upper edges of the diapophyses; in its course backwards, it gradually rises, till, at its posterior margin, it is about $\frac{3}{16}$ ths of an inch higher; in the third, the neural arch, at its posterior extremity, where it is highest, is exactly the same height as the diapophyses; and here the margin is about $\frac{3}{8}$ ths of an inch broad from side to side, and slightly notched in the middle. From this part these arches become gradually lower and lower, till in the tenth vertebra the top of the arch is almost flat, and about an eighth of an inch under the height of the diapophyses. In the eleventh the arch is quite flat, and is exactly at a right angle with the anterior face of the centrum: this, as well as some of the preceding vertebræ, has a round posterior margin, which begins a little behind the zygapophyses; they have likewise a small notch on the middle of their posterior edge. From this to the second last dorsal the arches are still flat; but in the last dorsal and succeeding lumbar they rise high in the middle; and then the neural spines, although not particularly prominent, are still distinctly developed. From the eleventh dorsal vertebra the round on the posterior margins of the neural arches becomes gradually less as they approach the first lumbar, where the margin is straight across; after this the margins are slightly concave, but in the posterior lumbar they are notched under the neural spines. The diapophyses are similar in size to those of the common Seal, *P. vitulina*; and there are metapophyses feebly developed on the last four dorsal vertebræ.

I have thus far attempted to describe this Pliocene Seal; for, although the bones of Seals have been occasionally met with in the upper clay-beds of Scotland and other places, they have heretofore been found in too detached and fragmentary a condition to admit of any description showing their specific identity.

How far the present Seal agrees with or differs from any of the existing species is the next point of importance to be considered. The broken condition of its cranium, the absence of the characteristic palatal and nasal bones, and the immature state of the specimen, on the one hand, and, on the other, the

little that seems to be known of the osteology of many of the recent species, the discrepancies in the different works on the subject, and the confusion in which some of the species are still enveloped, make this not a very easy nor perhaps certain matter. In *Phoca vitulina* the oblique insertion of the molar teeth, the two posterior cusps on those of the upper jaws, and the much larger size of the molar teeth of young individuals about the size of the fossil make it obvious that it does not belong to that species. *P. hispida* appears to me to be the next Seal deserving of notice; and the close resemblance its cranium bears to that of the fossil requires for it a somewhat lengthened comparison. The osteology of this species appears to be but indifferently known; but its cranium, as figured by F. Cuvier in the 'Mémoires du Muséum,' tome xi., agrees exactly with the fossil, so far at least as the latter is entire, not only in the extreme length, but when taken in detail. Thus, when the lower jaw is measured from the anterior edge of the canine tooth to the articular condyle, and then from the posterior edge of the glenoid cavity to the extremity of the occipital condyle, the lengths in both cases are exactly the same proportionally as those of the figure. F. Cuvier's description of the teeth is not very clear; he only says of them, "et qui ont des mâchelières un peu plus simples que celles du Phoque commun." Nilsson* appears to consider *P. hispida* as only a variety of his *P. annellata*, but states that he dare not positively say so; and of this variety he says that there are "nicht mehr als 1 Spitze hinter und 1 vor der Hauptspitze im Oberkiefer." This description is so applicable to the fossil teeth, that had Nilsson been decided that this variety included *P. hispida*, it would have gone far, I think, taken along with the corresponding size of the cranium to Cuvier's figure, to have settled the question as to the species. G. Cuvier's description of *P. hispida*† comes near enough the fossil: he says *P. hispida* resembles *P. Grænlandica* and *P. vitulina*, but has a larger head and a shorter snout; his account of the teeth, however, is somewhat at variance both with those of the fossil and with Nilsson's description given above: he says, "Ses dents sont comme au *Grænlandica*, et même les supérieures, excepté la dernière, manquant du petit lobe en avant." Such being the case, the next Seal deserving attention in connexion with the present inquiry seems to me to be *P. Grænlandica*, which, taken in all, appears to be the Seal to which the fossil has the closest alliance. Indeed, I have little doubt that it is a young individual of that species. At the same time there are one or two matters in connexion with this requiring a little consideration. Bell's

* Wiegmann's 'Archiv für Naturgeschichte,' 1841.

† Ossemens Fossiles, tome viii.

figure of the cranium of this Seal, in his 'British Quadrupeds,' appears to be drawn one-third of the natural size, and is the same proportionally as Home's full-sized figure*. When the fossil cranium is compared with these figures, the posterior part is found to be nearly the same in length. But there is a considerable difference in the length of the lower jaws: in the figures they are represented as 5 inches in length (that is, from the posterior part of the articular condyle to the anterior part of the canine tooth); in the fossil jaw the same measurement only gives $3\frac{1}{4}$ inches. In both cases, however, the teeth occupy precisely the same space proportionally in the jaws. The fossil teeth likewise agree in size with those of Home's figure: they are not, however, nearly so wide apart; but as they belong to an immature individual, perhaps the space between them would have gradually increased as the jaws grew longer. The lower jaw agrees with Bell's figure both in its upper curve and in the straight margin about the middle of its lower edge; the molar teeth, in like manner, are exactly the same in shape as those given in his figure. Most authors on the subject to whose works I have had access state that the anterior cusps are obsolete on the upper molar teeth of *P. Grænländica*; if this were invariably the case both in old and young animals, then, of course, there could be no doubt whatever that the specimen in question could not be of that species. Nevertheless these anterior cusps appear to me to be indicated in Prof. Bell's figure of the skull of this species, which Nilsson says belonged to a young animal. It would likewise appear, from F. Cuvier's description†, that these cusps were developed on the teeth of some at least of the crania examined by him, which he says he had of all ages, and remarks that the molars are small, separate from each other, "et qui n'ont qu'un seul petit tubercule en avant ou en arrière du grand, aux mâchelières supérieures." In the 'Dictionnaire d'Histoire Naturelle,' tome ix. 1847, the description of the teeth of *P. Grænländica* is "à mâchelières petites et écartées, n'ayant, à la mâchoire supérieure, qu'un seul tubercule en avant ou en arrière du tubercule moyen." Macgillivray gives a short notice, in the 'Nat. Library,' vol. vii., of a young individual of the present species examined by him: "It was 39 inches in length, the head being $6\frac{1}{4}$. The incisors conical, compressed; the canine teeth conical; the *grinders tricuspid*." This account is valuable, short though it be, as it shows the length of the head, in proportion to the body, in an individual about the size of the fossil, the skull of which, measured from the anterior of the lower canine, is $5\frac{7}{8}$ inches in length, to which a little must be added

* Philosophical Transactions, 1822.

† Mémoires du Muséum, tome xi.

for the projection of the upper jaw. It would likewise appear, both from the fossil and from Macgillivray's statement, that the head is larger in the young animal, in proportion to the body, than it is in the adult. Macgillivray does not give the length of the lower jaw of his specimen; but it will be seen, from the length of that organ already given, that in the fossil the extra size is in the cerebral portion of the cranium. In Prof. Owen's description of the skull of *P. Grænlandica**, which was originally figured by Home, and previously referred to, he speaks of "the principal cusp in all but the last lower molar having one accessory basal cusp in front, and two behind. According to Cuvier's statement in the 'Ossemens Fossiles,' this was likewise the cranium of a young animal. The truth would seem to be, that the cusps vary somewhat with age, and of course the number given by an author will depend much upon whether the animal he is describing be old or young. The dorsal vertebræ of *P. Grænlandica*, as described by Prof. Owen†, appear to correspond nearly with those of the fossil. The neural arches, he observes, of the middle dorsal vertebræ "are without spines, and are very narrow, leaving wide unprotected intervals of the neural canal." He also states that there are "metapophyses developed on the last five dorsal vertebræ." The vertebral formula, however, is somewhat different: he gives 4 sacral and 8 caudal for his specimen. In the fossil there are 3 sacral and 13 caudal (allowing Cuvier's opinion to be correct, that there are 4 sacral in the Seals when the animal is adult, there would still be 12 caudal), and metapophyses are only developed on the last 4 dorsal vertebræ. Whether these and some other minor characters are of sufficient specific importance to separate the fossil from *P. Grænlandica* I must meantime leave to those possessed of the requisite knowledge of the subject to determine. In 1860 there was a right humerus of a Seal found in the red clay of the Gar Bridge Tile-works: this clay is about 50 or 60 feet above the level of the sea, and some four miles west from St. Andrew's. This bone had belonged to a larger Seal than the preceding, but, except in its larger size, it does not differ from the humeri of the latter in any appreciable way; there are the same strongly pronounced deltoid ridges and the prominent inner tuberosity observable in both; they are likewise similar in having the inner condyle perforated for the passage of the cubital artery.

About the time that the last-mentioned Stratheden Seal was found, there were likewise discovered, in the same clay-bed, some bones apparently belonging to two genera of Ducks, which

* Catalogue, Osteological Series, Royal College of Surgeons, vol. ii.

† *Op. cit.*

are now, I believe, in the Natural History Museum, Aberdeen. I only saw a portion of these bones for a few minutes shortly after they were discovered, and have had no opportunity of examining them since; but Mr. Page (in whose possession they were) stated, at the Aberdeen Meeting of the British Association, that they belonged to some species of *Oidemia* and *Somateria*. However this may be, there is, in the Natural History Museum, St. Andrew's, the cranium of a duck, minus the bill, the zygomatic, tympanic, and pterygoid bones, that was found in the brick-clay of Tyrie, near Kirkaldy. This cranium has the closest resemblance to that of *Oidemia nigra*, but is much larger than the cranium of this or any other of the genus that now frequents our coasts. The skull of *O. perspicillata*, however, I have never seen; but Gould and others represent *O. fusca* as the largest of the genus. When the fossil cranium is compared with the latter species, it is found to be a full eighth of an inch larger in transverse diameter; its vertical diameter is likewise greatest. The cranium of *Somateria mollissima* exceeds the fossil in size exactly in the proportion that the latter exceeds *O. fusca*. If the body bore the same proportion to the cranium in Pliocene times as now, this Duck must have been intermediate in size between *O. fusca* and *S. mollissima*. This is the more remarkable when we consider the close resemblance which exists between the fossil cranium in all its parts and that of *O. nigra*; for, excepting the larger size of the former, there appears to me to be no tangible difference whatever in the crania of sufficient importance to separate them specifically. The fossil cranium is perhaps a little more depressed than the recent, and the post-orbital processes form a rather better defined angle on each side with the posterior of the orbital cavity than they do in *O. nigra*, and in this respect somewhat resemble *O. fusca*. But there are the superiorly approximating orbits, the upward and backward ascending processes on the lachrymal (?) bones; although large in the fossil, they form part of the circular ridge across the base of the bill, followed by a deep median depression, as in *O. nigra*. The foramina appear to be the same in both; the fossil cranium has likewise a single optic foramen, and well-defined grooves for the olfactory nerves.

XL.—*On the Habits of Pagurus Prideauxii and Adamsia palliata.* By Lieut.-Col. STUART WORTLEY.

IN the month of July last, while dredging on the 'Diamond' off Hastings, I obtained many specimens of this interesting Hermit Crab with its lovely lilac-and-white companion. I selected a pair, of convenient size, living in the shell of a *Natica monili-*